

C L A I M S

1. A biometric recognition apparatus
2 characterized by comprising:
3 a detection element which electrically
4 contacts an object;
5 a supply signal generating unit which
6 generates an AC supply signal;
7 a response signal generating unit which
8 includes a resistive element connected between said
9 supply signal generating unit and said detection
10 element, applies the supply signal to said detection
11 element through the resistive element, extracts, from
12 one terminal of the resistive element, a response signal
13 containing not less than one individual parameter which
14 changes depending on whether or not the object is a
15 living body, and outputs the signal;
16 a waveform information detection unit which
17 detects at least one of the individual parameters as
18 waveform information from the response signal, and
19 outputs a detection signal representing the waveform
20 information; and
21 a biometric recognition unit which determines
22 on the basis of the detection signal whether or not the
23 object is a living body.

2. A biometric recognition apparatus
2 according to claim 1, characterized in that the
3 individual parameters comprise a phase and amplitude of

4 the response signal which change in accordance with an
5 impedance of the object with which the apparatus is in
6 contact through said detection element.

3. A biometric recognition apparatus
2 according to claim 2, characterized in that said
3 waveform information detection unit detects a phase
4 difference between the supply signal and the response
5 signal as the waveform information.

4. A biometric recognition apparatus
2 according to claim 2, characterized in that said
3 waveform information detection unit detects a detection
4 signal corresponding to an amplitude peak value of the
5 response signal as the waveform information.

5. A biometric recognition apparatus
2 according to claim 2, characterized in that
3 said waveform information detection unit
4 separately detects waveform information representing a
5 phase of the response signal and waveform information
6 representing an amplitude of the response signal, and
7 said biometric recognition unit determines on
8 the basis of the respective detection signals
9 representing the pieces of waveform information whether
10 or not the object is a living body.

6. A biometric recognition apparatus
2 according to claim 1, characterized in that the
3 individual parameters comprise a real component and
4 imaginary component of an impedance of the object with

5 which the apparatus is in contact through said detection
6 element.

7. A biometric recognition apparatus
2 according to claim 6, characterized in that said
3 waveform information detection unit detects a phase
4 difference between the supply signal and the response
5 signal as waveform information representing the
6 imaginary component.

8. A biometric recognition apparatus
2 according to claim 6, characterized in that said
3 waveform information detection unit detects an amplitude
4 peak value of the response signal as waveform
5 information representing the real component.

9. A biometric recognition apparatus
2 according to claim 3, characterized in that
3 said detection element includes a first
4 detection electrode which electrically contacts the
5 object and is connected to a predetermined common
6 potential, and a second detection electrode which
7 electrically contacts the object,
8 said supply signal generating unit includes an
9 offset removing circuit which outputs an AC supply
10 signal as the supply signal from which an offset is
11 removed to make a central potential coincide with the
12 common potential,
13 said response signal generating unit applies
14 the supply signal to the second detection electrode of

15 said detection element, and outputs a signal as a
16 response signal which changes in phase in accordance
17 with the impedance of the object,
18 said waveform information detection unit
19 includes a level shift circuit which level-shifts the
20 response signal to make a central potential of the
21 response signal coincide with a central potential of a
22 reference signal synchronized with the supply signal,
23 detects, as waveform information of the response signal,
24 a phase difference obtained by comparing a phase of the
25 reference signal with the response signal level-shifted
26 by the level shift circuit, and outputs a detection
27 signal representing the waveform information, and
28 said biometric recognition unit determines on
29 the basis of the waveform information of the detection
30 signal whether or not the object is a living body.

10. A biometric recognition apparatus
2 according to claim 3, characterized in that
3 said detection element includes a first
4 detection electrode which electrically contacts the
5 object and is connected to a predetermined common
6 potential, and a second detection electrode which
7 electrically contacts the object,
8 said response signal generating unit applies
9 the supply signal to the second detection electrode of
10 said detection element, and outputs, as a response
11 signal, a signal whose phase has changed in accordance

12 with the impedance of the object with which the
13 apparatus is in contact through said detection element,
14 said waveform information detection unit
15 includes an offset correction circuit which corrects an
16 offset in the response signal so as to make a central
17 potential of the response signal coincide with a
18 predetermined reference potential used for the phase
19 comparison, and detects, as waveform information of the
20 response signal, a phase difference obtained by
21 comparing a phase of a reference signal synchronized
22 with the supply signal with a phase of the response
23 signal corrected by the offset correction circuit, and
24 said biometric recognition unit determines on
25 the basis of the waveform information of the detection
26 signal whether or not the object is a living body.

11. A biometric recognition apparatus
2 according to claim 3, characterized by further
3 comprising a reference potential supply unit which
4 supplies a reference potential equal to a central
5 potential of the supply signal to the first detection
6 electrode of said detection element,
7 wherein said detection element includes a
8 first detection electrode which electrically contacts
9 the object and is connected to a predetermined common
10 potential, and a second detection electrode which
11 electrically contacts the object,
12 said response signal generating unit applies

13 the supply signal to the second detection electrode of
14 said detection element, and outputs, as a response
15 signal, a signal whose phase has changed in accordance
16 with the impedance of the object with which the
17 apparatus is in contact through said detection element,
18 said waveform information detection unit
19 detects, as waveform information of the response signal,
20 a phase difference obtained by comparing a phase of a
21 reference signal synchronized with the supply signal
22 with a phase of the response signal, and
23 said biometric recognition unit determines on
24 the basis of the waveform information of the detection
25 signal whether or not the object is a living body.

12. A biometric recognition apparatus
2 according to claim 4, characterized in that
3 said detection element includes a first
4 detection electrode which electrically contacts the
5 object and is connected to a predetermined common
6 potential, and a second detection electrode which
7 electrically contacts the object,
8 said supply signal generating unit includes an
9 offset removing circuit which outputs an AC supply
10 signal obtained by removing an offset from the supply
11 signal so as to make a central potential of the supply
12 signal coincide with the common potential,
13 said response signal generating unit applies
14 the supply signal to the second detection electrode of

15 said detection element, and outputs, as a response
16 signal, a signal whose amplitude has changed in
17 accordance with the impedance of the object with which
18 the apparatus is in contact through said detection
19 element,
20 said waveform information detection unit
21 includes a maximum voltage detection circuit which
22 detects a maximum voltage value of the response signal
23 as the amplitude, and detects the amplitude obtained by
24 the maximum voltage detection unit as waveform
25 information of the response signal, and
26 said biometric recognition unit determines on
27 the basis of the waveform information of the detection
28 signal whether or not the object is a living body.

13. A biometric recognition apparatus
2 according to claim 4, characterized in that
3 said detection element includes a first
4 detection electrode which electrically contacts the
5 object and is connected to a predetermined common
6 potential, and a second detection electrode which
7 electrically contacts the object,
8 said response signal generating unit applies
9 the supply signal to the second detection electrode of
10 said detection element, and outputs, as a response
11 signal, a signal whose amplitude has changed in
12 accordance with the impedance of the object with which
13 the apparatus is in contact through said detection

14 element,
15 said waveform information detection unit
16 includes a peak voltage detection circuit which detects
17 a peak voltage value of the response signal, a central
18 voltage detection circuit which detects a central
19 voltage value of the response signal, and a voltage
20 comparison circuit which detects an amplitude of the
21 response signal by comparing the peak voltage value with
22 the central voltage value, and detects the amplitude
23 detected by the voltage comparison circuit as waveform
24 information of the response signal, and
25 said biometric recognition unit determines on
26 the basis of the waveform information of the detection
27 signal whether or not the object is a living body.

14. A biometric recognition apparatus
2 according to claim 4, characterized in that
3 said detection element includes a first
4 detection electrode which electrically contacts the
5 object and is connected to a predetermined common
6 potential, and a second detection electrode which
7 electrically contacts the object,
8 said response signal generating unit applies
9 the supply signal to the second detection electrode of
10 said detection element, and outputs, as a response
11 signal, a signal whose amplitude has changed in
12 accordance with the impedance of the object with which
13 the apparatus is in contact through said detection

14 element,
15 said waveform information detection unit
16 includes a maximum voltage detection circuit which
17 detects a maximum voltage value of the response signal,
18 a minimum detection circuit which detects a minimum
19 voltage value of the response signal, and a voltage
20 comparison circuit which compares the maximum voltage
21 value with the minimum voltage value to detect the
22 amplitude, and detects the amplitude as waveform
23 information of the response signal, and
24 said biometric recognition unit determines on
25 the basis of the waveform information of the detection
26 signal whether or not the object is a living body.

15. A biometric recognition apparatus
2 according to claim 1, characterized in that said
3 biometric recognition unit determines whether or not the
4 object is a living body, by comparing a recognition
5 index value obtained from the waveform information of
6 the detection signal with a reference range of a
7 plurality of recognition index value reference values
8 obtained under a plurality of measurement conditions.

16. A biometric recognition apparatus
2 according to claim 15, characterized in that said
3 biometric recognition unit performs the determination on
4 the basis of a plurality of recognition index values
5 obtained respectively for supply signals having
6 different frequencies generated by said supply signal

7 generating unit.

17. A biometric recognition apparatus
2 according to claim 15, characterized in that said
3 biometric recognition unit performs the determination on
4 the basis of a plurality of recognition index values
5 obtained respectively for different elapsed times from
6 the start of application of the supply signal.

18. A biometric recognition apparatus
2 according to claim 15, characterized in that when
3 comparing said each recognition index value with the
4 reference range, said biometric recognition unit uses an
5 individual reference range corresponding to a
6 measurement condition under which each recognition index
7 value is obtained.

19. A biometric recognition apparatus
2 according to claim 15, characterized in that said
3 waveform information detection unit detects a phase
4 difference between the response signal and a reference
5 signal synchronized with the supply signal as the
6 waveform information.

20. A biometric recognition apparatus
2 according to claim 15, characterized in that said
3 waveform information detection unit detects an amplitude
4 of the response signal with respect to a reference
5 signal synchronized with the supply signal as the
6 waveform information.

21. A biometric recognition apparatus

2 according to claim 15, characterized in that said
3 waveform information detection unit detects a phase
4 difference between the response signal and a reference
5 signal synchronized with the supply signal and an
6 amplitude of the response signal as the waveform
7 information.

22. A biometric recognition apparatus
2 according to claim 2, characterized in that said supply
3 signal generating unit includes a frequency generating
4 circuit which generates a rectangular wave signal having
5 a predetermined frequency, and a waveform shaping
6 circuit which extracts a desired frequency component
7 from the rectangular wave signal generated by said
8 frequency generating circuit as the supply signal, and
9 generates, as the supply signal, a supply signal formed
10 from an AC signal having a predetermined frequency.

23. A biometric recognition apparatus
2 according to claim 22, characterized in that said
3 waveform shaping circuit includes a low-pass filter
4 which extracts a desired low-frequency component from
5 the rectangular wave signal.

24. A biometric recognition apparatus
2 according to claim 22, characterized in that said
3 waveform shaping circuit includes an amplitude limiting
4 circuit which outputs the rectangular wave signal upon
5 limiting an amplitude thereof, a low-pass filter which
6 extracts a desired low-frequency component from the

7 signal obtained by the amplitude limiting circuit, and
8 an amplification circuit which outputs the signal
9 obtained by the low-pass filter upon amplifying the
10 signal.

25. A biometric recognition apparatus
2 according to claim 24, characterized in that said
3 amplitude limiting circuit includes a first reference
4 voltage generating circuit which generates a first
5 reference voltage, a second reference voltage generating
6 circuit which generates a second reference voltage, an
7 inverter circuit which outputs the rectangular wave
8 signal upon inverting a logical value of the signal, a
9 first switch element which intermittently outputs the
10 first reference voltage by performing switching
11 operation in accordance with the signal obtained by the
12 inverter circuit, and a second switch element which
13 intermittently outputs the second reference voltage at a
14 timing opposite to that of the first switch element by
15 performing switching operation in accordance with the
16 rectangular wave signal.

26. A biometric recognition apparatus
2 according to claim 24, characterized in that said
3 amplitude limiting circuit includes a first reference
4 voltage generating circuit which generates a first
5 reference voltage, a second reference voltage generating
6 circuit which generates a second reference voltage, a
7 first switch element which intermittently outputs the

8 first reference voltage by performing switching
9 operation in accordance with the rectangular wave
10 signal, and a second switch element which intermittently
11 outputs the second reference voltage at a timing
12 opposite to that of the first switch element by
13 performing switching operation in a phase opposite to
14 that of the first switch element in accordance with the
15 rectangular wave signal.

27. A biometric recognition apparatus
2 according to claim 22, characterized in that said
3 waveform shaping circuit includes an amplitude limiting
4 low-pass filter which limits an amplitude of the
5 rectangular wave signal and extracts a desired
6 low-frequency component from the rectangular wave
7 signal, and an amplification circuit which amplifies and
8 outputs the signal obtained by the low-pass filter.

28. A biometric recognition apparatus
2 according to claim 27, characterized in that said
3 amplitude limiting low-pass filter includes a first
4 resistive element having one terminal connected to a
5 first common potential, a second resistive element
6 having one terminal connected to a second common
7 potential, a first switch element which outputs the
8 first common potential through the first resistive
9 element by being connected to the other terminal of the
10 first resistive element and performing switching
11 operation with a predetermined polarity in accordance

12 with the rectangular wave signal, and a second switch
13 element which intermittently outputs the second common
14 potential through the second resistive element at a
15 timing opposite to that of the first switch element by
16 being connected to the other terminal of the second
17 resistive element and performing switching operation in
18 a phase opposite to that of the first switch element in
19 accordance with the rectangular wave signal.

29. A biometric recognition apparatus
2 according to claim 27, characterized in that the
3 amplitude limiting low-pass filter includes a first
4 reference voltage generating circuit which generates a
5 first reference voltage, a second reference voltage
6 generating circuit which generates a second reference
7 voltage, a first switch element which performs switching
8 operation upon input of the first reference voltage to a
9 control terminal and input of the rectangular wave
10 signal to an input terminal, and a second switch element
11 which performs switching operation in a phase opposite
12 to that of the first switch element upon input of the
13 second reference voltage to a control terminal and
14 connection of an output terminal of the first switch
15 element to an input terminal.

30. A biometric recognition apparatus
2 according to claim 22, characterized by further
3 comprising a frequency control unit which outputs a
4 frequency control signal which designates a frequency of

5 the supply signal,
6 wherein said frequency generating circuit
7 outputs a rectangular wave signal having a frequency
8 corresponding to the frequency control signal, and
9 said waveform shaping circuit extracts a
10 frequency component corresponding to the frequency
11 control signal from the rectangular wave signal and
12 outputs the frequency component as the supply signal.

31. A biometric recognition apparatus
2 according to claim 30, characterized in that said
3 waveform shaping circuit includes a variable low-pass
4 filter which extracts a low-frequency component
5 corresponding to the frequency control signal from the
6 rectangular wave signal.

32. A biometric recognition apparatus
2 according to claim 31, characterized in that said
3 variable low-pass filter includes a variable resistive
4 element which changes a resistance value in accordance
5 with the frequency control signal upon input of the
6 rectangular wave signal to one terminal, and a variable
7 capacitive element which changes a capacitance value in
8 accordance with the frequency control signal upon being
9 connected between the other terminal of the variable
10 resistive element and a predetermined low impedance
11 potential.